# Passive Sampling of PAHs and Some Trace Organic Compounds in Occupational and Residential Air – needs, evaluation and limits

Akademisk avhandling
för avläggande av medicine doktorsexamen vid Sahlgrenska Akademin
vid Göteborgs universitet

Avhandlingen kommer att offentligen försvaras i hörsal Karl Isaksson,
Arbets- och miljömedicin, Medicinaregatan 16 A, Göteborg,
fredagen den 28 maj 2010, kl. 09.00

av

**Pernilla Bohlin**

Fakultetsopponent:
Professor Keri Hornbuckle,
Department of Civil and Environmental Engineering, University of Iowa, Iowa, USA

Avhandlingen baseras på följande arbeten:

I. **Bohlin, P., Jones, K. C. and Strandberg, B.** "Occupational and indoor air exposure to persistent organic pollutants: A review of passive sampling techniques and needs." *Journal of Environmental Monitoring* 2007; 9:501-509.

II. **Bohlin, P., Jones, K. C., Tovalin, H., and Strandberg, B.** "Observations on persistent organic pollutants in indoor and outdoor air using passive polyurethane foam samplers." *Atmospheric Environment* 2008; 42:7234-7241.

III. **Bohlin, P., Jones, K. C. and Strandberg, B.** "Field evaluation of polyurethane foam passive air samplers to assess airborne PAHs in occupational environments." *Environmental Science & Technology* 2010; 44 (2):749-754.

IV. **Bohlin, P., Jones, K. C., Levin J-O., Lindahl R. and Strandberg, B.** "Field evaluation of a personal passive air sampler for PAH exposure in workplaces". *Journal of Environmental Monitoring* 2010; Accepted, DOI:10.1039/C0EM00018C.

UNIVERSITY OF GOTHENBURG

Göteborg 2010

# Passive Sampling of PAHs and Some Trace Organic Compounds in Occupational and Residential air – needs, evaluation and limits

**Pernilla Bohlin**
Occupational and Environmental Medicine, School of Public Health and Community Medicine, Institute of Medicine, University of Gothenburg, Gothenburg, Sweden

## ABSTRACT

Human exposure to elevated levels of polycyclic aromatic hydrocarbons (PAHs) and trace organic compounds (e.g. PCB, OCP, PBDE) can be related to negative health effects. This raises demands of exposure measurements to be performed. Passive air samplers (PAS) are simple and cheap sampling options that may be useful tools for exposure screening of large populations. They can also enable frequent monitoring. The aim of this thesis was to evaluate and increase the understanding of PAS methods to sample and monitor PAHs and some trace organic compounds in occupational and residential air.

A polyurethane foam (PUF) based PAS was considered having the best potential and was chosen for the evaluation. Two designs of this PUF-PAS were evaluated: one for stationary sampling shaped as a disk and one for personal sampling shaped as a cylinder ("mini-PUF").

The results presented show that PUF-PAS disks and mini-PUFs provide detectable levels for most of the studied compounds under typical occupational and residential air concentrations. They also showed potential to detect spatial differences in concentrations between and within sampling sites as well as inside and outside homes. The novel use of the mini-PUF was successful both as stationary and personal sampler. Moreover, the precision of gas phase PAHs in replicates of PUF-PAS disks and mini-PUFs were comparable to precision for active samplers while particle-associated PAHs showed more variable results. Results from personally deployed mini-PUFs were significantly correlated to personal active samplers for the studied compounds and the accuracy was high for most compounds.

Sampling rates ($R_S$) for 16 individual PAHs ranged from 1 to 10 $m^3$ $day^{-1}$ (0.7-7 L $min^{-1}$) in PUF-PAS disks, from 0.4 to 3.3 $m^3$ $day^{-1}$ (0.3-2.3 L $min^{-1}$) in mini-PUFs deployed for two weeks as well as 8 h. No significant differences in $R_S$ were found for PAHs in the gas phase and PAHs associated to particles. The $R_S$ was higher for the mini-PUF compared to the PUF-PAS disk when correcting for their surface areas indicating a more efficient uptake in the mini-PUF design. Somewhat higher $R_S$ was also found for gas phase PAHs for the 8 h exposure compared to two weeks exposure.

In conclusion, this thesis demonstrates that PUF-PAS disks can be a useful tool for screening of PAH concentrations in occupational environments. The mini-PUF has a good potential to be used as a personal sampler for PAHs in occupational environments but requires further validation.

**Key words:** passive air sampler, PUF, PAH, POP, occupational environment, residential environment, evaluation, exposure, stationary sampling, personal sampling

ISBN 978-91-628-8066-8

http://hdl.handle.net/2077/21945